P. 6
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BULLETIN

OF THE

State University of New Mexico

WHOLE NUMBER 114

GEODOGICAL SERIES SEPTEMBER, 1923 VOL. III, NO. 6

Tables for Determining Common Minerals and Rocks

BY

ROBERT W. ELLIS
PROFESSOR OF GEOLOGY IN THE STATE UNIVERSITY
AND STATE GEOLOGIST

ALBUQUERQUE, NEW MEXICO
1923

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PREFACE

The following tables have been prepared to enable the student beginning geology to make a rapid and relatively accurate determination of some of the more common minerals and rocks. Many text-books of physical geology give but little attention to rocks and minerals. It seems important to the writer to base all geological study on a certain knowledge of the materials which make up the earth's surface and upon which the several dynamic process have operated. An intellegent study of rocks involves at least an elementary knowledge of some minerals. Besides being an aid to the understanding of the principles of geology, a familiarity with the minerals and rocks of common occurrence is a desirable possesion for many persons who have not had opportunity to take a course in geology. It is hoped that the outlines will be found useful to anyone who wishes to pursue the study of minerals and rocks at home.

In the preparing of the descriptive matter the writer has made free use of standard texts by Dana, Pirsson, Moses and Parsons, Rogers, Brush and Penfield, Kemp, Ries, etc.

—R. W. E.

Albuquerque, New Mexico, Aug. 30, 1923.

DETERMINING MINERALS AND ROCKS

A WORD TO THE STUDENT

In studying a specimen the student is cautioned against the impulse to hurry to a determination of the name of the mineral, or rock, without regard to detail in his observations. The most important mental acquirement in the process of the determination is the ability to make careful and complete observations. Every individual feature of the specimen should be noticed and briefly recorded. Time thus spent will also result in a more permanent retention of the characteristics of the specimen.

Ordinarily, the first noticeable feature of a mineral is its color. In the tables there are eight groups based on color. If there is doubt as to the color of the mineral it may be necessary to follow through color groups that grade into each other.

To determine the streak, the mineral is carefully drawn across the surface of unglazed porcelain, such as a floor tile or the edge of a broken dish. In case the mineral is too hard to make a mark, its streak may be found by powdering it finely and rubbing the powder on white paper.

The hardness of a mineral is the degree of resistance it offers to abrasion. As minerals vary much in hardness, a certain classification can be made on this property. The standard scale of hardnes is as follows: Talc, 1; gypsum, 2; calcite, 3; fluorite, 4; apatite, 5; orthoclase, 6; quartz, 7; topaz, 8; corundum, 9; diamond, 10. Since the beginner can hardly be expected to be able to use this scale before he has learned the respective minerals named in it, a few common substances are suggested, with their approximate hardnesses: Lead (bullet or pipe), 1.5; thumb nail, 2.25; copper cent, 3; oyster shell, 3.5; steel nail, 4; pocket knife, 5.25; window glass, 5.5; steel file, 6.25. A corner of the mineral should be drawn across the surface of the object whose hardness is known; if a permanent scratch is left, the mineral is the harder of the two materials. The test may also be made by attempting to scratch the given mineral by a corner of the hardness tester.

The degree of precision used will govern the outcome of subsequent procedure. A small error at one point may place you on the wrong track.

With the color, streak, and hardness determined, reference should be made to the descriptions of the minerals of the particular group. The numbers following the names of minerals in the classification correspond with numbers in the succeeding descriptions.

A similar plan is arranged for the determination of rocks. It will be found more difficult to determine rocks than minerals, since many rocks grade into one another and their descriptions can not be made so distinct. A field determination is preferable to the study of a hand specimen, as the relations and structural features are there more readily observed.

Very simple apparatus will suffice for most determinations. The student should have a pocket lens, and for collecting material a square-faced hammer is desirable. If hydrochloric (muriatic) acid is not at hand, strong vinegar may be used for testing carbonates.

GENERAL CLASSIFICATION OF MINERALS

I. WHITE OR COLORLESS

A. STREAK WHITE OR GRAY

Hardness=1.

Carnallite	16
Talc	54

Hardness=1.5

Talc	54
Gypsum	61

Hardness=2.

Muscovite	48
Kaolinite	55
Gypsum	61
Sylvite	14
Clinochlore	52

Hardness=2.5

Halite	13
Muscovite	48
Lepidolite	49
Barite	59
Clinochlore	52

Hardness=3.

Calcite	27
Barite	59
Anhydrite	60
Lepidolite	49

Hardness=3.5

Sphalerite	8
Dolomite	28
Lepidolite	49
Barite	59
Anhydrite	60
Magnesite	29
Siderite	30

Hardness=4.

Sphalerite	8
Fluorite	15
Dolomite	28
Lepidolite	49
Colemanite	58
Magnesite	29
Siderite	30

Hardness=4.5

Calamine	45
Colemanite	58
Magnesite	29

Hardness=5.

Smithsonite	31
Calamine	45
Apatite	56
Pyroxene	38

Hardness=5.5

Opal	18
Leucite	36
Nephelite	37
Pyroxene	38
Tremolite	40

Hardness=6

Opal	18
Cassiterite	23
Orthoclase	34
Albite	35
Leucite	36
Nephelite	37
Pyroxene	38

Hardness =6.5

Opal	18
Cassiterite	23
Albite	35
Garnet	42

Hardness=7.

Quartz	17
Cassiterite	23
Garnet	42

Hardness=8.

Topaz	44

Hardness=9.

Corundum	20

II. YELLOW

A. STREAK WHITE OR GRAY

Hardness=1.

Bauxite	26

Hardness =1.5

Sulphur	2
Bauxite	26
Gypsum	61

Hardness=2.

Sulphur	2
Bauxite	26
Clinochlore	52
Gypsum	61

Hardness=2.5

Sulphur	2
Halite	13
Bauxite	26
Clinochlore	52
Biotite	50
Serpentine	53
Barite	59

Hardness=3.

Bauxite	26
Calcite	27
Biotite	50
Serpentine	53
Barite	59

Hardness=3.5

Sphalerite	6
Serpentine	53
Barite	59

Hardness=4.

Sphalerite	8
Fluorite	15
Siderite	30
Serpentine	53

Hardness=4.5

Calamine	45

Hardness=5.

Calamine	45
Apatite	56

Hardness=5.5

Opal	18
Nephelite	37

Hardness=6.

Opal	18
Cassiterite	23
Orthoclase	34
Nephelite	37

Hardness=6.5

Opal	18
Cassiterite	23
Garnet	42

Hardness=7.

Quartz	17
Cassiterite	23
Garnet	42
Staurolite	47

Hardness=7.5

Garnet	42
Staurolite	47

Hardness=8.

Beryl	41
Topaz	44

Hardness=9.

Corundum	20

B. STREAK YELLOW

Hardiness=1.

Bauxite	26

Hardness=1.5

Bauxite	26

Hardness=2.

Bauxite	26
Kaolinite	55

Hardness=2.5.

Gold	3
Copper	4
Bauxite	26
Kaolinite	55

Hardness=3.

Copper	4
Bauxite	26

Hardness=3.5

Sphalerite	8
Magnesite	29

Hardness=4.

Sphalerite	8
Magnesite	29

Hardness=4.5

Magnesite	29

Hardness=5.

Limonite	25

Hardness=5.5

Limonite	25

C. STREAK GREEN

Hardness=3.5

Chalcopyrite 10

Hardness=4.

Chalcopyrite 10

Hardness=6.

Pyrite 11
Marcasite 12

D. STREAK BLACK OR BROWN

Hardness=1-3

Bauxite 26

Hardness=3.5-4.

Sphalerite 8
Chalcopyrite 10

Hardness=5-5.5

Limonite 25

Hardness=6-6.5

Pyrite 11
Marcasite 12
Cassiterite 23

Hardness=7.

Cassiterite 23

III. RED OR PINK

A. STREAK WHITE OR GRAY

Hardness=1.

Carnallite 16

Hardness=1.5.

Gypsum 61

Hardness=2.

Muscovite 48
Gypsum 61

Hardness=2.5

Halite 13
Muscovite 48
Lepidolite 49
Biotite 50
Serpentine 53
Barite 59

Hardness=3.

Lepidolite 49
Barite 59
Anhydrite 60

Hardness=3.5

Dolomite 28
Siderite 30
Lepidolite 49
Barite 59
Anhydrite 60

Hardness=4.

Fluorite 15
Dolomite 28
Siderite 30
Lepidolite 49

Hardness=5.

Apatite 56

Hardness=5.5.

Opal 18

Hardness=6.

Opal 18
Orthoclase 34
Nephelite 37

Hardness=6.5

Opal 18
Garnet 42
Chrysolite 43

Hardness=7.

Quartz 17
Garnet 42
Chrysolite 43
Tourmaline 46
Staurolite 47

Hardness=7.5.

Beryl 41
Garnet 42
Tourmaline 46
Staurolite 47

Hardness=8.

Beryl 41
Topaz 44

Hardness=9.

Corundum 20

B. STREAK RED

Hardness=1-2.

Some earthy varieties of
hematite 21
Bauxite 26

Hardness=2.5-3

Bauxite 26

Copper 4

Hardness=3.5-4.

Cuprite 19

Hardness=5-6.5.

Hematite 21

C. STREAK BROWN

Hardness=2-2.5

Kaolinite	55

Hardness=2.5-3.

Copper	4

Hardness=3.5-4.

Cuprite	19

Hardness=5-6.5.

Hematite	21

Hardness=6.5-7.

Cassiterite	23

IV. BROWN

A. STREAK WHITE OR GRAY

Hardness=1.5.

Sulphur	2

Hardness=2.

Sulphur	2
Muscovite	48
Biotite	50

Hardness=2.5

Muscovite	48
Biotite	50
Barite	59

Hardness=3.

Calcite	27
Biotite	50
Barite	59

Hardness=3.5.

Sphalerite	8
Dolomite	28
Magnesite	29
Siderite	30
Barite	59

Hardness=4.

Sphalerite	8
Fluorite	15
Dolomite	28
Magnesite	29
Siderite	30

Hardness=4.5.

Magnesite	29
Calamine	45

Hardness=5.

Smithsonite	31
Pyroxene	38
Hornblende	39
Calamine	45
Apatite	56

Hardness=5.5.

Opal	18
Pyroxene	38
Hornblende	39

Hardness=6.

Opal	18
Pyroxene	38
Hornblende	39

Hardness=6.5.

Opal	18
Garnet	42
Chrysolite	43

Hardness=7.

Quartz	17
Garnet	42
Staurolite	47

Hardness=7.5.

Staurolite	47

Hardness=9.

Corundum	20

B. STREAK YELLOW

Hardness=2-2.5

Kaolinite	55

Hardness=3.

Calcite	27

Hardness=3.5.

Sphalerite	8
Dolomite	28

Hardness=4.

Sphalerite	8
Siderite	30

Hardness=5-5.5.

Limonite	25

Hardness=6.5-7.

Chrysolite	43

C. STREAK BROWN

Hardness=1-1.5.

Bauxite	26

Hardness=2-2.5.

Bauxite	26
Kaolinite	55

Hardness=3.

Bornite	9
Bauxite	26

Hardness=3.5.
Sphalerite 8
Cuprite 19

Hardness=4.
Sphalerite 8

Siderite 30

Hardness=5-5.5.
Limonite 25

Hardness=6-6.5.
Cassiterite 23

D. STREAK RED

Hardness=5-6.5.
Hematite 21

E. STREAK WHITE OR GRAY

Hardness=3.
Bornite 9

Hardness=7-7.5.
Staurolite 47

V. BLACK

A. STREAK WHITE OR GRAY

Hardness=1-1.5.
Graphite 1

Hardness=2.
Graphite 2
Argentite 6
Pyrolusite 24

Hardness=2.5.
Galena 5
Argentite 6
Chalcocite 7
Biotite 50

Hardness=3.
Chalcocite 7
Calcite 27
Biotite 50

Hardness=3.5-4.
Dolomite 28

Hardness=5-5.5.
Pyroxene 38
Hornblende 39

Hardness=6.
Cassiterite 23
Pyroxene 38
Hornblende 39

Hardness=6.5.
Cassiterite 23
Garnet 42

Hardness=7.
Quartz 17
Cassiterite 23
Garnet 42
Tourmaline 46
Staurolite 47

Hardness=7.5.
Garnet 42
Tourmaline 46
Staurolite 47

B. STREAK GREEN

Hardness=5-6.
Pyroxene 38
Hornblende 39

C. STREAK YELLOW

Hardness=3.5-4.
Sphalerite 8

Hardness=5-5.5.
Limonite 25

D. STREAK BROWN

Hardness=3-3.5.
Sphalerite 8

Hardness=5-5.5.
Limonite 25

Hardness=6-7.
Cassiterite 23

E. STREAK RED

Hardness=5-6.5.

Hematite 21

F. STREAK BLACK OR DARK GRAY

Hardness=1-1.5.

Graphite 1

Hardness=2.

Argentite 6
Pyrolusite 24

Hardness=2.5.

Galena 5
Argentite 6
Chalcocite 7
Pyrolusite 24

Hardness=3.

Chalcocite 7
Bornite 9

Hardness=5.5-6.5.

Magnetite 22

Hardness=7-7.5

Tourmaline 46

VI. GRAY

A. STREAK GRAY

Hardness=1-1.5.

Graphite 1

Hardness=2.

Graphite 1
Argentite 6
Pyrolusite 24

Hardness=2.5.

Galena 5
Argentite 6
Chalcocite 7
Pyrolusite 24

Hardness=3.

Chalcocite 7

Hardness=6-6.5.

Marcasite 12

B. STREAK WHITE

Hardness=1.

Bauxite 26
Talc 54

Hardness=1.5.

Sulphur 2
Bauxite 26
Talc 54
Gypsum 61

Hardness=2.

Sulphur 2
Bauxite 26
Muscovite 48
Lepidolite 49
Kaolinite 55

Hardness=2.5.

Sulphur 2
Bauxite 26
Muscovite 48
Lepidolite 49
Serpentine 53
Kaolinite 55
Barite 59

Hardness=3.

Bauxite 26
Calcite 27
Lepidolite 49
Serpentine 53
Barite 59
Anhydrite 60

Hardness=3.5.

Dolomite 28
Magnesite 29
Siderite 30
Lepidolite 49
Serpentine 53
Barite 59
Anhydrite 60

Hardness=4.

Dolomite 28
Magnesite 29
Siderite 30
Lepidolite 49
Serpentine 53
Colemanite 58

Hardness=4.5.

Magnesite 29
Colemanite 58

Hardness=5.

Smithsonite 31
Pyroxene 38
Hornblende 39
Apatite 56

Hardness=5.5.

Opal 18
Leucite 36
Nephelite 37
Pyroxene 38
Hornblende 39
Tremolite 40

Hardness=6.

Opal	18
Cassiterite	23
Orthoclase	34
Albite	35
Leucite	36
Nephelite	37
Pyroxene	38
Hornblende	39

Hardness=6.5.

Opal	18
Cassiterite	23
Albite	35

Hardness=7.

Cassiterite	23

Hardness=7.5.

Beryl	41

Hardness=8.

Beryl	41
Topaz	44

Hardness=9.

Corundum	20

C. STREAK BROWN

Hardness=6-6.5.

Marcasite	12

D. STREAK RED

Hardness=5-6.5.

Hematite	21

E. STREAK BLACK

Hardness=1-1.5.

Graphite	1

Hardness=2.

Graphite	1
Argentite	6
Pyrolusite	24

Hardness=2.5.

Galena	5
Argentite	6
Chalcocite	7
Pyrolusite	24

Hardness=3.

Chalcocite	7

Hardness=6-6.5.

Marcasite	12

VII. GREEN

A. STREAK WHITE OR GRAY

Hardness=1-1.5.

Prochlorite	51
Talc	54

Hardness=2.

Muscovite	48
Prochlorite	51
Clinochlore	52

Hardness=2.5.

Muscovite	48
Biotite	50
Clinochore	52
Serpentine	53

Hardness=3.

Calcite	27
Biotite	50
Serpentine	53

Hardness=3.5.

Dolomite	28
Serpentine	53

Hardness=4.

Fluorite	15
Dolomite	28
Siderite	30
Serpentine	53

Hardness=4.5.

Calamine	45

Hardness=5.

Smithsonite	31
Pyroxene	38
Hornblende	39
Calamine	45
Apatite	56
Turquoise	57

Hardness 5.5.

Opal	18
Nephelite	37
Pyroxene	38
Hornblende	39
Turquoise	57

Hardness=6.	
Opal	18
Orthoclase	34
Albite	35
Nephelite	37
Pyroxene	33
Hornblende	39
Turquoise	57

Hardness=6.5.	
Opal	18
Albite	35
Garnet	42
Chrysolite	43

Hardness=7.	
Quartz	17
Garnet	42
Chrysolite	43
Tourmaline	46

Hardness=7.5.	
Beryl	41
Garnet	42
Tourmaline	46

Hardness=8.	
Beryl	41
Topaz	44

B. STREAK GREEN

Hardness=1-1.5.	
Prochlorite	51

Hardness=2.	
Prochlorite	51
Clinochlore	52

Hardness=2.5.	
Clinochlore	52

Hardness=3.5.-4.	
Malachite	32

Hardness=5-6.	
Pyroxene	38
Hornblende	39
Turquoise	57

VIII. BLUE OR VIOLET

A. STREAK WHITE OR GRAY

Hardness=1.5.2	
Gypsum	61

Hardness=2.5.	
Halite	13
Barite	59

Hardness=3.	
Calcite	27
Barite	59
Anhydrite	60

Hardness=3.5.	
Barite	59
Anhydrite	60

Hardness=4.	
Fluorite	15

Hardness=4.5.	
Calamine	45

Hardness=5.	
Smithsonite	31
Calamine	45
Apatite	56
Turquoise	57

Hardness=5.5.	
Opal	18
Nephelite	37
Turquoise	57

Hardness=6.	
Opal	18
Albite	35
Nephelite	37
Turquoise	57

Hardness=6.5.	
Opal	18
Albite	35

Hardness=7.	
Quartz	17
Tourmaline	46

Hardness=7.5.	
Beryl	41
Tourmaline	46

Hardness=8.	
Beryl	41
Topaz	44

Hardness=9.	
Corundum	20

B. STREAK BLUE

Hardness=2-2.5.	
Pyrolusite	24

Hardness=3.5-4.	
Azurite	33

C. STREAK GREEN

Hardness=5-6.	
Turquoise	57

DESCRIPTION OF MINERALS

NATIVE ELEMENTS

1. *Graphite.*

Lead-black to steel-gray. Metallic luster. Greasy feel. Streak, lead-colored. H.=less than 1, to 2, soiling the fingers. G.=2.09-2.23. Cleavage in one direction. Resembles molybdenite but is lower in specific gravity. Composition, carbon (C). Used for lead-pencils, lubricant, crucibles, stove polish. Occurs in metamorphic rocks, being often the result of metamorphism of coal beds. Also called plumbago or black lead.

2. *Sulphur.*

Yellow. Resinous luster. Brittle. White streak. H.=1.5-2.5. G.=2.05-2.09. Burns with a blue flame and gives off a strong choking gas (sulphur dioxide). Composition, sulphur (S), often with impurities. Used in the manufacture of sulphuric acid, in paper making, in making matches, gunpowder, insecticides, in vulcanizing rubber. Occurs in beds of gypsum and associated rocks; around volcanoes and mineral springs. In the United States, it is most abundant in Louisiana and Texas.

3. *Gold.*

Yellow. Metallic luster. Malleable. H.=2.5-3. G.=15.6-19.3. Streak, yellow. Composition, gold (Au), but usually alloyed with silver. The chief ore of gold. Occurs most commonly in quartz veins and in placer deposits.

4. *Copper.*

Copper-red. Metallic luster. Malleable. Streak like the color, and shining. H.=2.5-3. G.=8.8-8.9. Composition, copper (Cu), often with a little silver. An important ore of copper. Occurs usually as a secondary deposit. The most important region of its occurence is the Keweenaw peninsula, Michigan.

SULPHIDES

5. *Galena.*

Lead-gray. Metallic luster. Streak, lead-gray. Cleavage, cubic, perfect. H.=2.5-2.75. G.=7.4-7.6. Composition, lead sulphide (PbS). The most important ore of lead. Widely distributed; occurs in Missouri, Wisconsin, and Illinois, associated with zinc sulphide. Also known as galenite and lead glance.

6. *Argentite.*
Dark lead-gray. Metallic luster. Sectile. Streak, lead-gray. H.=2-2.5. G.=7.20-7.36. Composition, silver sulphide (Ag_2S). An important ore of silver. Known also as silver glance.

7. *Chalcocite.*
Blackish lead-gray, often tarnished black. Metallic luster. Rather sectile. More brittle than argentite. H.=2.5-3. G.=5.5-5.8. Composition, cuprous sulphide (Cu_2S). An important ore of copper. Occurs usually as a secondary deposit in copper veins. Notable deposits at Butte, Montana; Clifton, Arizona; Copper River district, Alaska. Called copper glance, by miners.

8. *Sphalerite.*
Yellowish brown, black, brownish, or almost colorless. Luster, resinous to adamantine, or submetallic. Cleavage, dodecahedral, perfect. H.=3.5-4. G.=3.9-4.1. Streak, brownish to yellow or white. Composition, zinc sulphide (ZnS.) The most important ore of zinc. Occurs notably in southwestern Missouri, associated with galena, marcasite, and calcite in limestone rocks. Called zinc blende or black jack.

9. *Bornite.*
Brownish bronze, purplish brown, iridescent tarnish. Brittle. Metallic luster. Streak, grayish black. Magnetic after heating. H.=3. G.=4.9-5.4. Composition, copper-iron sulphide (Cu_5FeS_4). An ore of copper. Occurs as a primary mineral in igneous rocks or as a secondary deposit in veins.

10. *Chalcopyrite.*
Bright brass-yellow, often tarnished or iridescent. Metallic luster. Streak, greenish black. Brittle. H.=3.5-4. G.=4.1-4.3. The most important ore of copper. Commonly occurs as a primary deposit in veins; also is found in basic igneous rocks. Composition, a copper-iron sulphide ($CuFeS_2$). Called copper pyrites.

11. *Pyrite.*
Pale brass-yellow. Metallic luster. Streak, greenish black or brownish black. Brittle. H.=6-6.5. G.=4.95-5.10. Composition, iron disulphide (FeS_2). Not an iron ore, but is used mainly in the manufacture of sulphuric acid; often carries gold. It is of wide occurrence. Other names, iron pyrites, fool's gold.

12. *Marcasite.*
Pale brass-yellow, with a grayish to greenish tinge.

Metallic luster. Fracture, rough. Brittle. It is paler than pyrite, and is more unstable. Common forms of occurrence are stalactitic, disc-shaped, etc., with a radiated structure; also crest-like and spearhead forms. H.=6-6.5. G.=4.85-4.90. Composition, iron disulphide (FeS_2). Occurs in coal beds and other sedimentary rocks, usually being a deposit from surface solutions rather than from deep-seated sources.

HALOIDS, ETC.

13. *Halite.*

Colorless, white, often reddish or bluish. Cleavage, cubic. Form, in cubes, granular, or massive. Taste, salty. Luster, vitreous. H.=2.5. G.=2.1-2.6. Composition, sodium chloride ($NaCl$). A preservative, household uses; in the manufacture of soap and glass. Occurs in extensive beds, associated with gypsum, due to the evaporation of sea-water; in salt lakes and the ocean. Deposits, in New York, Michigan, Louisiana, Kansas, New Mexico, etc. Commonly called salt.

14. *Sylvite.*

Colorless or white. Cleavage, cubic. Taste, salty but bitter. H.=2. G.=1.99. Composition, potassium chloride (KCl). Used as a fertilizer and a source of potash. Occurs in beds, associated with other soluble salts, at Stassfurt, Germany; in shallow lakes in western Nebraska.

15. *Fluorite.*

White, various tints of blue, green, purple, or brown. Cleavage, good, in four directions, forming perfect octahedrons. H.=4. G.=3.01-3.25. Crystallizes in cubes, or in tufts or rosettes. Transparent to translucent. Streak white. Composition, calcium fluoride (CaF_2). Used as a flux in steel manufacture; in enameling; in making opalescent glass, and in preparing hydrofluoric acid. Occurs commonly as a vein deposit, associated with galena and sphalerite. Commercially known as fluor spar.

16. *Carnallite.*

White or colorless, often reddish. Taste, bitter. Deliquescent. H.=1. G.=1.60. Composition, hydrous potassium-magnesium chloride ($KMgCl_3.6H_2O$). Used as fertilizer. Occurs in beds, at Stassfurt.

OXIDES

17. *Quartz.*

White to colorless; may be almost any color, owing to impurities. Luster, vitreous, sometimes greasy. H.= 7. G.=2.65-2.66. Fracture, conchoidal to subconchoidal. Transparent to opaque. Insoluble in most acids. Composition, silicon dioxide (SiO_2). The crystal and colored forms, used as jewelry or ornaments; the prime constituent of sandstone and quartzite; an abrasive; for making glass; for concrete. Of very wide occurrence; as a constituent of granite and other igneous rocks; as the main component of sandstones and beds of sand and gravel; and as a gangue in mineral veins.

VARIETIES OF QUARTZ.

A. CRYSTALLIZED, WITH VITREOUS LUSTER.

a. **Rock Crystal.**
Colorless or clear. With, or without, crystal form.

b. **Milky Quartz.**
White. Nearly opaque. Luster, often greasy. Occurs commonly in veins and pegmatite dikes; the quartz of igneous rocks is commonly of this type.

c. **Rose Quartz.**
Pink or rose-colored. Occurs in pegmatite dikes, usually in rather large masses.

d. **Amethyst.**
Purplish or lavender-colored. Nearly transparent. Used as gem.

e. **Smoky Quartz.**
Smoky yellow to dark brown tinge. Nearly transparent in thin pieces.

f. **Citrine.**
Clear yellow. Called false topaz.

g. **Cats Eye.**
Grayish brown or greenish. Opalescent.

B. NOT VISIBLY CRYSTALLIZED, HAVING A DULL OR WAXY LUSTER. NEVER CLEAR.

a. **Chalcedony.**
Pale blue, gray, or white, sometimes brownish. Occurs commonly as a lining to cavities in rocks.

b. **Agate.**
Colors in bands or layers, concentric or irregular, as having been deposited by water in rough cavities in rock.

c. **Moss Agate.**
Chalcedony containing moss-like figures of brown or black.

d. **Onyx.**
Colors in plane layers. A kind of agate.

e. **Flint.**
Smoky gray to nearly black. Fracture, broadly conchoidal. Formerly much used for weapons and implements. Occurs as nodules in chalk beds; also, in thin layers in some limestones; it is to this form that the term chert is probably more commonly applied.

f. **Jasper.**
Red, yellow, or brown; also greenish and bluish. Opaque.

18. *Opal.*

All colors or colorless; often a rich play of colors. Transparent or translucent. Luster, vitreous; sometimes resinous or pearly. H.=5.5-6.5. G.=1.9-2.3. Composition, hydrous silica (SiO_2nH_2O). Some varieties are used as gems. Occurs as a deposit in seams and cavities in igneous rocks; also embedded in limestones and shales in concretion-like masses; deposited from the waters of hot springs; as deposits of diatomaceous earth and concretionary masses therein.

VARIETIES OF OPAL.

a. **Precious Opal.**
Shows play of colors.

b. **Fire Opal.**
Red to yellow, with flash of color on turning.

c. **Common Opal.**
Any color, but not a play of colors. Translucent to opaque.

d. **Wood Opal.**
Wood petrified by opal.

e. **Hyalite.**
Colorless. Like bunches of drops

f. **Geyserite.**
White. Porous, concretionary deposits around geysers.

g. **Diatomaceous Earth.**
White. In masses or beds. Somewhat porous and friable. The remains of diatoms.

19. *Cuprite.*

Cochineal-red, various other shades of red. Streak, red. Luster, adamantine to submetallic. H.=3.5-4. G.=5.85-6.15. Not magnetic before or after heating.

Composition, cuprous oxide (Cu_2O). A rich copper ore. A secondary deposit in the oxidized zone. Called red copper ore.

20. *Corundum.*

Bluish gray, brown, red, and other colors. H.=9. G.=3.95-4.10. Luster, adamantine to vitreous. Tough and difficult to break when in large masses. Has a property resembling cleavage· Composition, aluminum oxide (Al_2O_3). Some varieties are valuable for gems; formerly the common varieties were used as an abrasive. Occurs in certain igneous and metamorphic rocks.

VARIETIES OF CORUNDUM.

a. **Corundum.**
The common, massive variety.

b. **Emery.**
Granular, containing magnetite or hematite.

c. **Sapphire.**
Blue. Transparent to translucent. A gem.

d. **Ruby.**
Red. Transparent to translucent. A gem; some specimens, more valuable than the diamond.

21. *Hematite.*

Cherry-red, reddish brown, dark steel-gray, or black. Streak, red or reddish brown. Magnetic after heating, but not before. Luster, metallic to dull. Various forms—fibrous and splintery, oolitic, scale-like, massive, and earthy. H.=5-6.5. G.=4.9-5.3. Earthy forms show a lower degree of hardness. Composition, ferric oxide (Fe_2O_3). The most important iron ore; also used in paints. Widely distributed, and in rocks of all geological ages; the most important locality in the United States is the Lake Superior region; Alabama, near Birmingham, is a notable producer.

VARIETIES OF HEMATITE.

a. **Red Hematite.**
Red to brownish red. Massive to earthy. The Mesabi range, Minnesota, produces this type.

b. **Specular Iron.**
Steel-gray or black. Luster, metallic and glistening. In crystals or as scale-like masses.

c. **Oolitic.**
Red. Masses composed of rounded grains and particles resembling fragments of shells. Called, also, Clinton iron ore; Alabama ores, of this type.

22. *Magnetite.*

Black. Magnetic. Streak, black. Luster, metallic to dull. H.=5.5-6.5. G.=5.1-5.2. Composition, ferrous-ferric oxide (Fe_3O_4). Important ore of iron.

23. *Cassiterite.*

Brown or black. H.=6.-7. G.=6.8-71. Luster, adamantine. In masses or grains. Composition, tin oxide (SnO_2). The most common ore of tin. Occurs in sands and gravels; most commonly occurs in veins in granites.

24. *Pyrolusite.*

Black, steel-gray, bluish. Streak, black. H.=1.-2.5. G.=4.73-4.86. Often soft enough to soil the fingers. Fibrous and columnar forms, common; also in masses or as needle-like crystals. Composition, manganese dioxide (MnO_2). An ore of manganese; as a coloring in bricks, etc., and various other uses.

25. *Limonite.*

Yellow, brown, or nearly black. Streak, yellowish brown. Luster, silky or submetallic. Usually fibrous in structure; in layers or crusts; rounded, concretionary forms; porous or earthy masses; "iron rust." H.=5.-5.5. G.=3.6-4. Earthy forms easily marking paper. Composition, ferric hydroxide ($2Fe_2O_3.3H_2O$). An important iron ore; as a paint. Differs from hematite in containing water. A resulting product from the decomposition of other minerals containing iron, as residual material or as a deposit from solution. The characteristic material of the "iron hat" of certain ore veins. Called brown hematite.

VARIETIES OF LIMONITE.

a. **Compact.**
Luster, silky to submetallic. Fibrous structure and rounded forms.

b. **Ocherous.**
Yellow or brownish. Often mixed with soil, to which it gives a characteristic color.

c. **Bog Ore.**
Loose, yellowish. Found in marshes.

26. *Bauxite.*

White, yellowish white, brown, or red. Usually in masses of rounded, concretionary particles an eighth of an inch in diameter and smaller; sometimes earthy. H.=1-3. G.=2.5. Composition, essentially aluminum hydroxide ($Al_2O_3.2H_2O$); is not a true mineral. An ore of aluminum. Occurs in Arkansas; also in Georgia and Alabama.

CARBONATES

27. *Calcite.*

Colorless or white; also tints of blue, red, green, etc.; may be brown or black, when impure. Cleavage, perfect rhombohedral. Transparent to opaque. H.=3. G.=2.71. Effervesces in acid.

VARIETIES OF CALCITE.

a. **Crystals (and fragments of crystals).**
Dog-tooth spar; nail-head spar; Iceland spar.

b. **Satin Spar.**
Fibrous, with a silky luster.

c. **Travertine.**
Coarsely fibrous or columnar in structure. Formed around springs; the columnar structure, developing normal to the surface of evaporation, is often in layers.

d. **Mexican Onyx.**
Similar to travertine in origin, but usually a finer structure and a more delicately banded appearance. Used for ornaments, table-tops, etc.

e. **Stalactites.**
Cylindrcial or conical forms suspended from the roofs of caves. Formed by the evaporation of water dripping from the ceiling.

f. **Stalagmite.**
Material deposited on the floor of caves, from the water dripping from the ceiling.

g. **Marble.**
Massive, crystalline texture, White, clouded to grayish or bluish, yellowish, brownish. Certain impure forms containing fossil shells, or having the impurities distributed in an irregular, angular fashion often classed here. Extensively used for interior work in public buildings and offices.

h. **Limestone.**
In masses or beds. Various colors, usually grayish, bluish, or buff. Usually compact; sometimes crystalline, sometimes showing oolitic or highly fossiliferous structure; other kinds with a considerable amount of impurities, such as clay or silt. More strictly, a rock. A building material, an ingredient of Portland cement, etc.

i. **Chalk.**
White, yellowish, or grayish. Soft enough to make a mark on a board but usually having

some cohesiveness. Useful for Portland cement; also for various other purposes.

j. **Marl.**

A soft, earthy, whitish material, with or without visible pieces of shells. Useful for Portland cement.

28. *Dolomite.*

White, reddish, or grayish; also green, brown, or black. Resembles calcite, but does not effervesce in cold acid, unless powdered. Effervesces in hot acid. H.=3.5-4. G.=2.8-2.9. Crystals, commonly curved or saddle-shaped. Cleavage, rhombohedral. Composition, calcium-magnesium carbonate ($CaMgC_2O_6$). For building stone and furnace linings. Occurs extensively; forms the southern Tyrol Alps. Is a secondary rock, having been formed from ordinary limestone by replacement.

29. *Magnesite.*

White or gray; also yellowish or brownish. Commonly massive, compact; sometimes shows cleavage. Fracture, flat conchoidal. Luster, vitreous to dull. Composition, magnesium carbonate ($MgCO_3$). H.=3.5-4.5. G.=3.-3.12. Used for brick for lining furnaces in steel works; various chemicals, as epsom salts. A secondary mineral; occurs in talc schist, serpentine, etc.

30. *Siderite.*

Brownish, grayish, brownish red; sometimes white. Crystals, rhombohedral, often curved. Cleavage, rhombohedral. H.=3.5-4. G.=3.83-3.88. Luster, vitreous to pearly. Magnetic after heating. Effervesces slowly in cold acid; readily in hot. Composition, ferrous carbonate ($FeCO_3$). Minor ore of iron.

31. *Smithsonite.*

Greenish, grayish, bluish, brown. H.=5. G.=4.30-4.45. Rounded, crust-like forms, as if deposited from solution around irregular surfaces--called "reniform" or "botryoidal." Composition, zinc carbonate ($ZnCO_3$). An important ore of zinc. Distinguished from calamine by its effervescence in acid. Usually found in the oxidized zone.

32. *Malachite.*

Bright green. Luster, silky or vitreous. Streak, pale green. Commonly encrusting, with fibrous structure. H.=3.5-4. G.=3.9-4.03. Effervesces in acid. Composition, basic copper carbonate ($CuCO_3.Cu(OH)_2$).

An ore of copper; sometimes as an ornamental stone; as a pigment. Occurs in the oxidized zone.

33. *Azurite.*

Azure blue. Streak, light blue. Luster, vitreous· H.=3.5-4. G.=3.77-3.83. Effervesces in acid. Composition, basic copper carbonate ($2CuCO_3.Cu(OH)_2$). An ore of copper. Occurs in the oxidzed zone.

SILICATES

FELDSPAR GROUP

34. *Orthoclase.*

Flesh-red, white, colorless, pale yellow. Cleavage, in two directions almost rectangular. H.=6. G.=2.57. Not effervescing in acid. Resembles microcline, which is of a different crystallographic system. Composition, potassium-aluminum silicate ($KAl2Si_8O_8$). Used in the manufacture of porcelain. Occurs in igneous rocks, especially in granites.

35. *Albite.*

White; also bluish, reddish, or gray. Not surely distinguished from other feldspars except optically; certain fine striations appearing on the base of the crystal distinguish this mineral from orthoclase. Resembles barite, but is harder. H.=6-6.5. G.=2.62-2.65. Composition, sodium-aluminum silicate ($NaAlSi_3O_8$). Use, same as orthoclase; a variety showing a play of colors on a cleavage surface is used for jewelry, and is called moonstone. Occurs in many igneous rocks; common in pegmatite dikes, associated with tourmaline, lepidolite, etc. Albite is one of the so-called plagioclase feldspars.

FELDSPATHOID GROUP

36. *Leucite.*

White, gray. Usually in form of trapezohedral crystals (tetragonal trisoctahedron.) H.=5.5-6. G.=2.45-2.50. Luster, vitreous. Composition, potassium-aluminum silicate ($K_2O.Al_2O_3.4SiO_2$). Occurs in igneous rocks, especially in lavas, taking the place of feldspars. In Vesuvius lavas; Leucite Hills, Wyoming.

37. *Nephelite.*

Gray, white, colorless; also greenish gray or reddish. Luster, greasy to vitrous. Crystals are hexagonal.

H.=5.5-6. G.=2.55-2.65. Composition, sodium-aluminum silicate ($NaAlSiO_4$). Occurs in igneous rocks; associated with leucite. Other names, nepheline; elaeolite.

PYROXENE GROUP

38. *Pyroxene.*

Green of various shades, from nearly white to black, usually dull. H.=5-6. G.=3.2-3.6. Luster, vitreous to resinous. Crystals usually short and thick. Cleavage, nearly at right angles but imperfect.

VARIETIES OF PYROXENE.

a. **Augite.**

Black, greenish. Usually in short, thick crystals, nearly square or octagonal. H.=5.5. G.=3.3. Composition, a silicate mainly of calcium, magnesium, aluminum, and iron ($CaMgSi^2O^6$) mixed with (Mg,Fe) ($AlFe$)^2 SiO^6. Occurs in basic extrusives.

b. **Diopside.**

White, gray, or green. Crystals, prismatic, usually four or eight-sided. H.=5-6. G.=3.29. Composition, calcium-magnesium silicate ($CaMgSi^2O^6$). Occurs in gabbros and peridotites; also in metamorphic rocks.

AMPHIBOLE GROUP

39. *Hornblende.*

Dark green, dark brown to black. H.=5.5. G.=3.05-3.47. Cleavage, prismatic, forming angles of 56° and 124°, thus distinguishing it from pyroxene. Luster vitreous to silky. Composition, a complex silicate of calcium, magnesium, iron, and aluminum, with fluorine and hydroxyl. Occurs in igneous rocks, such as granites, syenites, diorites, andesites, and some basalts; also in schists and gneissess. Hornblende is one of a large group of minerals and it has numerous varieties.

40. *Tremolite.*

White to dark gray. Fibrous or columnar masses; in crystals, long and bladed or short and thick. Cleavage, of the hornblende habit—in two directions, forming angles of 56° and 124°. H.=5.5. G.=2.9-3.1. Composition, calcium-magnesium silicate ($CaMg_3Si_4O_{12}$). Fibrous forms of tremolite, and of other varieties of amphibole not containing aluminum, are called asbestus. As such, they are useful for making fireproof cloth and other non-combustible articles.

41. *Beryl.*

Tints of green, sometimes white; also light blue, yellow, and pale pink. H.=7.5-8. G.=2.63-2.80. Luster, vitreous. Crystals, six-sided. Composition, beryllium-aluminum silicate ($3BeO.Al_2O_3.6SiO_2$). A gem stone. In pegmatite veins, in the Black Hills, and in San Diego County, California; in mica schists, and in some sedimentary rocks.

VARIETIES OF BERYL.

a. **Emerald.**
Bright emerald-green. A valuable gem. Occurs near Muzo, Columbia, South America.

b. **Ordinary Beryl.**
Various colors, pale green the most common.

GARNET GROUP

42. *Garnet.*

Red, brown, yellow; also white, apple-green, black. H.=6.5-7.5. G.=3.15-4.3. Luster, vitreous to resinous. Streak, white. Crystals, dodecahedron and trapezohedron common forms; also, these in combination. Composition, various silicates of calcium, magnesium, aluminum, and iron; also, of chromium and manganese. Used as an abrasive; some kinds are used as gems. Occurs in metamorphosed limestones, schists, pegmatites, lavas, etc.

VARIETIES OF GARNET.

a. **Almandite.**
Deep red to black. Transparent to translucent. G.=4.25. Includes precious garnet in part and common garnet in part. Composition, ($FeO.Al^2O^3.3SiO^2$). Some specimens used as gems.

b. **Andradite.**
Yellow, green, red, brown, black, in various tints. G.=3.75. Composition, ($3CaO.Fe^2O^3.3SiO^2$). Common garnet.

OLIVINE GROUP

43. *Olivine.*

Yellowish green, olive green; sometimes brownish. H.=6.5-7. G.=3.27-3.37. Granular masses, usually. Luster, vitreous. Composition, magnesium-iron silicate $(Mg,Fe)_2SiO_4$). Some varieties used as a gem, called peridot. Occurs as an igneous rock; also, as the result of metamorphism of sedimentary rocks. Other names, chrysolite, peridot.

44. *Topaz.*

Colorless, pale yellow, white, bluish, greenish, reddish. H.=8. G.=3.4-3.6. Cleavage, perfect, parallel to base of crystal. Composition, aluminum fluo-silicate $(AlF)_2SiO_4$); hydroxyl may replace part of the fluorine A gem stone. Occurs in cavities in granites and rhyolites. In Colorado, Utah, Maine, Mexico, Ural Mts.

45. *Calamine.*

White, colorless; sometimes bluish, greenish, or brownish. Cleavage, perfect in one direction. H.=4.5-5. G.=3.40-3.50. Luster, vitreous. In aggregates or coatings. Composition, zinc silicate ($H_2O.2ZnO.SiO_2$). An ore of zinc. Occurs in oxidized zone, being derived from sphalerite. Associated with smithsonite, which it resembles.

46. *Tourmaline.*

Black; also brown, blue, green, red and pink. Brittle. H.=7.-7.5. G.=2.98-3.20. In crystals, attached or embedded; also columnar. A cross-section of the crystal three-, six-, or nine-sided; often somewhat rounded. Composition, a complex silicate of boron and aluminum, with iron, magnesium, or the alkalies. The brightly-colored varieties are used as gems. Occurs in pegmatite veins, often associated with beryl, lepidolite, albite, fluorite, quartz, etc. Black Hills; San Diego County, California; Maine; Massachusetts, etc.

VARIETIES OF TOURMALINE.

a. **Ordinary.**
Black. Associated with muscovite or biotite.

b. **Rubellite.**
Red to pink Associated with lepidolite.

47. *Staurolite.*

Brown. H.=7.-7.5. G.=3.65-3.77. Crystals commonly twinned, producing cross-like forms, whence the name. Composition, iron-aluminum silicate ($H_2O.2FeO.5Al_2O_3.4SiO_2$). Used as ornament, especially the forms that are a perfect cross. Occurs usually in mica schists, often associated with garnet, tourmaline, etc. In New England states; Georgia; Ducktown, Tenn.; Taos County, New Mexico.

MICA GROUP

48. *Muscovite.*

Colorless, brownish, greenish; rarely reddish. Transparent to translucent. Cleavage, exceptionally perfect, in one direction; into thin, elastic sheets. H.=2-2.5 G.=2.76-3. In cleavage masses and in scales. Composition, potassium-aluminum silicate, generally, ($H_2KAl_3(SiO_4)_3$). Used as an insulator in electrical apparatus; as a lubricant; for stove doors, etc. Occurs widely, in granites, pegmatites, schists, and gneisses. In many places in the Appalachian region; South Dakota; Idaho; New Mexico. Improperly called "isinglass"; also called potash mica.

VARIETIES OF MUSCOVITE.

a. **Ordinary Muscovite.**

b. **Sericite.**
Fine silky or scaly masses, often called talc schist; formed by the weathering of feldspars, etc.

49. *Lepidolite.*
Rose-red, violet-gray, lilac, or white. Cleavage, perfect, in one direction. Usually in scaly masses. H.=2.5.-4. G.=2.8-2.9. Composition, lithium-potassium-aluminum fluo-silicate ($LiKAl_2(OH,F)(SiO_3)_3$). A source of lithium. Occurs in pegmatite dikes, associated with spodumene, albite, fluorite, etc., in Taos County, New Mexico; with rubellite, near San Diego, California. Used in making opal glass, etc.

50. *Biotite.*
Black to brown; sometimes green. Opaque to transparent, according to thickness of sheets. Cleavage, exceptionally perfect, and as in muscovite. Luster, pearly to vitrous. H.=2.5-3. G.=2.7-3.1. Composi- ($(H,K)_2(Mg,Fe)_2Al_2(SiO_4)_3$). Occurs in many igneous rocks, especially in granites, syenites, diorites, rhyolites, etc.; also, in schists and gneisses. On Vesuvius; associated with muscovite in the New England states.

CHLORITE GROUP

51. *Prochlorite.*
Green, of various shades. Cleavage, like mica, but the sheets not elastic. Massive, foliated, or granular forms. Translucent to opaque. H.=1-2. G.=2.78-2.96. Composition, acid magnesium-aluminum-iron silicate ($H_{40}(Fe,Mg)_{23}Al_{14}Si_{13}O_{90}$). A secondary mineral in igneous and metamorphic rocks, derived from biotite, hornblende, etc.

52. *Clinochlore.*

Green of various shades; also, yellowish and white. Cleavage, very perfect, in one direction; laminae tough but not elastic. H.=2-2.5. G.=2.65-2.78. Composition, similar to that of prochlorite, but with more silicon and less ferrous iron.

53. *Serpentine.*

Yellowish green, blackish green, olive-green. Luster, oily to waxy. Usually massive; sometimes finely fibrous. H.=2.5-4. G.=2.50-2.65. Composition, hydrous magnesium silicate ($3MgO.2\ SiO_2.2H_2O$). Used in interior decoration, as wainscoting, mantels, etc.; the fibrous variety is one kind of asbestos. Occurs always as a secondary product of the alteration of such minerals as olivine, hornblende, pyroxene. Also called serpentine marble. Name derived from the resemblance of the rock to a snake's skin.

VARIETIES OF SERPENTINE.

a. **Massive.**
Ordinary serpentine, varying shades of color.

b. **Chrysotile.**
Fibrous, in soft, silky masses filling seams in serpentine rocks. Commercially important as asbestos. The most of the world's production comes from southern Quebec.

c. **Serpentine Rock.**
Large masses, often mixed with more or less of calcite or dolomite. Sometimes mottled with red. Ophicalcite, verde antique, serpentine marble, etc.

54. *Talc.*

White, gray or pale apple-green. Feel, soapy. Cleavage, perfect, in one direction. Usually in scaly or foliated masses. H.=1-1.5. G.=2.7-2.8. Luster, pearly. Composition, acid metasilicate of magnesium ($H_2O.3MgO.4SiO_2$). Coarser varieties used for table tops, sinks, etc.; for pencils; for toilet powders, etc. A stable product of the zone of weathering, being derived from the alteration of magnesium-bearing rocks such as tremolite, etc.

VARIETIES OF TALC.

a. **Foliated.**
Greenish white, or white, usually. Used as filler in paper, toilet powder, etc.

b. **French Chalk.**
White. Compact and soft. Used for pencils, tips of gas burners, etc.

c. **Soapstone.**
Gray to greenish. Generally coarsely granular. H.=1.5-2.5. Used for sinks, table tops, etc. Known as steatite.

55. *Kaolinite.*
White, yellowish to brownish, etc. Clay-like masses, usually. H.=2-2.5. G.=2.6-2.63. Usually unctuous and plastic. Composition, hydrous aluminum silicate $(2H_2O.Al_2O_3.2SiO_2)$. Used in manufacture of porcelain, china; the basis of most clays, in which form it is used for pottery, brick, etc. Occurs in the zone of weathering, resulting from the decomposition of the feldspars, etc.; in beds or irregular masses. In China, near Jauchau Fu; Delaware; Silverton, Colorado, etc.

PHOSPHATES, BORATES, ETC.

56. *Apatite.*
Sea-green, gray, reddish, brownish, bluish; sometimes white. In crystals of hexagonal form, and massive. H.=5. G.=3.17-3.23. Luster, vitreous to resinous. Cleavage, imperfect, parallel to base of crystal. Composition, $(3Ca_3P_2O_8.CaF_2)$. Useful as a source of phosphorous in the manufacture of fertilizers. Occurs most commonly in metamorphic rocks, especially in granular limestone; in veins, associated with tin ore, etc.; in small amounts in igneous rocks; in pegmatite dikes. In Norway; Cornwall, England; New England states and various places in the Appalachian region; very extensively in southern Canada. Named apatite on account of the difficulty in identifying the mineral by older mineralogists.

57. *Turquoise.*
Bluish green, sky-blue; becomes paler on exposure. Usually massive, in incrustations. Fracture, conchoidal. H.=5-6. G.=2.6-2.83. Composition, $(Al_2(OH)PO_4.H_2O)$, with some copper, giving the color; a hydrous phosphate of aluminum and copper. Much used as a gem; prepared and set in silver rings and bracelets by the Pueblo Indians. Occurs in brecciated trachyte, in Persia; in andesite, in Los Cerrillos Mountains, New Mexico; Nev.; Calif., San Bernardino Co.; Ariz.; Colo.; Mexico.

58. *Colemanite.*
Colorless or white. Cleavage, perfect, in one direction. In crystals or granular masses. Luster, adamantine to vitreous. H.=4-4.5. G.=2.42. Composition, hydrous calcium borate $(Ca_2B_6O_{11}.5H_2O)$. Source of borax and

boric acid. Occurs in shales, near Calico, San Bernardino County, Calif.; abundant near Daggett, in Mojave Desert.

SULPHATES

59. *Barite.*

Colorless, white, yellowish, gray, bluish, reddish, brownish, etc. In crystals, usually flat; also in rounded forms, with radiated or fibrous structure; lamellar; crested; granular; earthy. Cleavage, perfect, in three directions. H.=2.5-3.5. G.=4.3-4.6. Transparent to opaque. Composition, barium sulphate ($BaSO_4$). Used in making paint; in the manufacture of barium salts, etc. Occurs in veins, associated with ores of lead and zinc, calcite, etc.; in masses in beds of hematite; in veins in sedimentary rocks; as residual material from the weathering of limestone. One of the heaviest of transparent minerals; the name is derived from a word meaning weight. Called heavy spar, barytes.

60. *Anhydrite.*

White; colorless, grayish, bluish, or reddish. Usually in granular masses; sometimes in cleavable masses. Cleavage, in three directions at right angles. H.=3-3.5. G.=2.9-2.98. Luster, pearly to vitrous. Does not effervesce in acid. Composition, anhydrous calcium sulphate ($CaSO_4$). Occurs in beds, as the result of deposition from sea water; associated with rock salt and gypsum; often found with the "red beds."

61. *Gypsum.*

Colorless, white; sometimes yellowish, grayish, or pinkish, on account of impurities. Luster, vitreous, pearly, or silky. Cleavage, eminent, in one direction, into thin, somewhat flexible leaves that are not elastic. Massive varieties do not show cleavage, and fibrous varieties are not representative of the property quickly noticeable in the crystal. H.=1.5-2. G.=2.31-2.33. Used for making plaster of Paris; wall plaster; as a retarder in Portland cement, etc.; as a fertilizer, to neutralize black alkali; alabaster is carved into ornaments. Occurs in beds, similar to the occurrence of anhydrite, and is a deposit from evaporating inland seas, alternating with limestone and salt. Some beds of gypsum are the result of weathering on anhydrite. Produced sometimes in sedimentary rocks by the oxidation of pyrite and the consequent formation of sulphuric acid, which reacts on the calcium carbonate in the rocks. Is found widely distributed; N. Y.; Mich.; Ohio; Iowa; Va.; Kan.; Okla.; N. Mex.

VARIETIES OF GYPSUM.

a. **Selenite.**
Colorless, transparent crystals or foliated masses.

b. **Satin Spar.**
White, translucent, fibrous masses, having a satiny luster. Splits rather easily.

c. **Alabaster.**
White, translucent, fine-grained masses. Used for carving into ornaments, etc.

d. **Rock Gypsum.**
Dirty white or dull-colored, more or less compact rock, with impurities of clay, etc.

THE DETERMINATION OF ROCKS

The term "rock" is applicable to large and frequently recurring portions of the earth's crust, regardless of their mineral content; but most rocks are combinations of two or more minerals, or, if essentially of one mineral, contain certain impurities. Minerals as related to rocks are like the different materials used in building in their relation to the structure as a whole. The individual material may be just concrete, or just steel, or just lumber; as in a rock the individual mineral may be pure quartz, or pure calcite, or pure kaolin. Minerals are called rocks when they occur in very large masses; as, for instance, vein deposits of pure quartz, deposits of pure gypsum, etc.

The scientific study of rocks involves the consideration of their origin, their composition, their place of occurrence, their structure; it takes account of the changes they have undergone subsequent to the operation of the processes that may be said to have produced them; notes their uses, etc. Classified according to origin, we have igneous rocks and sedimentary rocks. A third class appears when we consider certain changes that have taken place in either of the two classes since their first formation. Rocks of the third class are called metamorphic.

Igneous rocks are those that have formed from a cooling magma, or melted mass. They may be at the earth's surface or deep below it. They may have taken their present position as outflows over the surface or by the removal of overlying material through the processes of weathering and erosion

Sedimentary rocks are formed by the accumulation of fragmental material, or material in solution, that has been derived from the decomposition and disintegration of other rocks or that has come from highly-heated portions of the earth. The accumulation is due to the action of wind and moving water or is dependent on the presence of bodies of water, which favor the assorting and deposition of material. Sedimentary rocks are usually stratified and often contain the shells or forms of organisms.

Metamorphic rocks are the result of the action of crustal movements, heat, or mineralized solutions on previously-formed rocks at considerable depth from the surface. Sometimes a combination of these agencies has produced the metamorphism. Often the former structure of the rocks is discernible, but usually all evidence of the original condition of the rocks is obliterated.

The properties of rocks that are the most useful in their determination are structure, texture, composition, general hardness, and color. By structure is meant the form and arrangement of the larger features of the rock, as stratification, solidity or porosity, foliation, etc.

Texture refers to the relative fineness or coarseness of grain of the minutest portion of the rock. In igneous and metamorphic rocks this would usually mean the degree or the relative coarseness of the crystallization. Great coarseness generally means very slow cooling of the magma. In sedimentary rocks, texture may refer to the size of the component grains, or to their absence; or to the degree of the crystallization.

By composition is meant the mineral composition rather than the chemical. In coarse-textured rocks the minerals are often .discernible.

Rocks do not usually have a certain degree of hardness, as minerals do, and this property can not be relied on precisely. But there is considerable difference between the hardness of sedimentary rocks like limestone or gypsum and most igneous rocks.

The colors of rocks are so variable that they are not to be depended upon without the confirmation of other tests. As a rule the acidic igneous rocks are light-colored, while the basic are dark-colored. Probably most limestones are light-colored and most shales are dark-colored. The weathered surface of a rock has a different color from the freshly-broken surface. The same type of rock may exhibit different colors in different specimens.

GENERAL CLASSIFICATION OF ROCKS

I. MASSIVE AND SOLID

A. TEXTURE GLASSY

Obsidian	1	Perlite	3
Pitchstone	2		

B. TEXTURE DENSE
HARDER THAN 5.

Rhyolite	9	Flint	20
Andesite	10	Jasper	21
Basalt	11	Novaculite	35
Diabase	12		

C. TEXTURE DENSE
SOFTER THAN 5.

Limestone	30, 31	Serpentine	45

D. TEXTURE GRAINED OR CRYSTALLINE
HARDER THAN 5.

Diabase	12	Diorite	16
Granite	13	Gabbro	17
Syenite	14	Gneiss	37
Monzonite	15	Quartzite	41

E. TEXTURE GRAINED OR CRYSTALLINE
SOFTER THAN 5.

Rock Salt	18	Ophicalcite	44
Gypsum	19	Serpentine	45
Limestone	30, 31, 32	Soapstone	46
Marble	42, 43		

F. TEXTURE PORPHYRITIC

Obsidian	1	Basalt	11
Pitchstone	2	Granite	13
Rhyolite	9	Syenite	14
Andesite	10	Monzonite	15

II. MASSIVE AND CELLULAR

A. TEXTURE GLASSY

Pumice	4

B. TEXTURE DENSE

Scoria	5	Calcareous Tufa	24
Basalt	11	Buhrstone	
Geyserite	22		

III. GRANULAR, FRIABLE OR UNCONSOLIDATED

A. TEXTURE GLASSY OR GRAIN FINE

Volcanic Dust	6	Loess	34
Diatomite	23	Clay	
Chalk	26	Silt	
Marl	27		

B. GRAIN MEDIUM, SANDY

Volcanic Dust	6	Sand	

C. FRAGMENTS OVER 1-8 INCH IN DIAMETER, ROUNDED OR ROUGH

Lapilli	8	Gravel	

IV. STRATIFIED OR BEDDED, MORE OR LESS CONSOLIDATED

A. TEXTURE FINE OR DENSE

Chert	20	Limestone	30, 31, 32
Diatomite	23	Shale	33
Chalk	26	Novaculite	35
Marl	27		

B. TEXTURE OR GRAIN MEDIUM

Sandstone	36

C. FRAGMENTS OVER 1-8 INCH DIAMETER, ROUNDED OR ANGULAR

Breccia	7 etc.	Conglomerate	37

V. GRANULAR, MASSIVE TO BEDDED. MORE OR LESS CONSOLIDATED

A. TEXTURE OR GRAIN FINE

Volcanic Dust	6	Marl	27
Diatomite	23	Shale	33
Chalk	26	Loess	34

B. TEXTURE MEDIUM, GRAINS VISIBLE

Volcanic Tuff	7	Oolitic Limestone	29
Marl	27	Sandstone	36

C. FRAGMENTS OVER 1-8 INCH DIAMETER ROUNDED OR ANGULAR

Breccia	7 etc.	Conglomerate	37
Coquina	28		

VI. NODULAR, SOMETIMES WITH CONCENTRIC LAYERS; OR RADIATED; OR ENCRUSTED

A. TEXTURE DENSE

Flint	20

B. TEXTURE EARTHY TO COMPACT

Geyserite	22	Concretions	
Calcareous Tufa	24		

VII. FIBROUS, RADIATED, OR COLUMNAR

Satin Spar	19 etc.	Travertine	25

VIII. BANDS OF COLORS

Mexican Onyx	25	Limestone	31
Agate		Sandstone	36
Jaspilite			

IX. ARBORESCENT TO CORALLOID OR LOBED

Geyserite ....22 Calcareous Tufa 24

X. FOLIATED OR LAMINATED. LAYERS SEPARABLE OR NOT

A. TEXTURE OR GRAIN FINE

Slate ....40 Schist 39

B. TEXTURE MEDIUM; MINERALS DISCERNIBLE

Schist 39

C. TEXTURE COARSE. STRUCTURE LESS LAMINATED; OFTEN CONTORTED

Gneiss 38

DESCRIPTION OF ROCKS

IGNEOUS ROCKS

1. *Obsidian.*

Texture, glassy. Structure, massive, solid; sometimes with spherulites, or with bubble-like cavities; sometimes showing flowage, as if drawn out. Luster, vitreous on fresh fracture. Color, black or brownish red. Opaque to translucent; sometimes transparent on thin edges. Fracture, conchoidal. Composition, high in silica, low in bases except the alkalies; a natural glass. Formerly used by the Indians for arrow points, etc.; some local use as a road metal. Wide occurrence in the West; Yellowstone National Park, etc.

2. *Pitchstone.*

Texture, glassy. Luster, resinous to vitreous. Structure, massive, solid. Fracture, small conchoidal. Color, yellowish, gray, reddish brown, black. Composition, like obsidian, but with 5 to 10% of water. Occurrence, similar to obsidian; Arran, Scotland; Meissen, Saxony.

3. *Perlite.*

Texture, glassy. Luster, pearly. Structure, many small, concentric fractures, giving an onion-like appearance to parts of the mass; somewhat pearl-like. Composition, similar to obsidian, with 2 to 4% of water. Color, gray to blue-gray.

4. *Pumice.*

Texture, glassy, as seen in small fragments. Structure, very porous, so that the stone floats on water. Color, usually white or gray; sometimes yellowish. Composition, similar to obsidian. Used as an abrasive. Occurs in volcanic regions; Lipari Islands, most abundant source; many places in the West.

5. *Scoria.*

   Structure, porous or vesicular. Texture, usually dense, as seen in small fragments. Color, black or dark; also reddish. Relatively heavy. Composition, low in silica, high in bases. Occurs widely, as a froth on lava flows.

6. *Volcanic Dust.*

   White, finely powdered pumice, having little coherence. Texture, glassy. Structure, fragments of pumice that has been exploded by the steam or gases within as it was being ejected from a volcano; the fragments are sharp or angular. Composition, similar to obsidian. Used as an abrasive; for scouring-soaps, as the "Old Dutch Cleanser"; for cement, etc. Occurs widely in in the West; in nearly every county in Nebraska.

7. *Volcanic Tuff.*

   White to gray, pink, brown, sometimes darker. Structure, massive; made up of fragments of volcanic materials fused or cemented together; often contains crystals of quartz or other minerals. With larger fragments, the rock is called volcanic breccia. The fragments are of various colors and textures.

8. *Lapilli.*

   Unconsolidated fragments of volcanic materials, as pieces of pumice, in size like fine gravel. Color, brown or gray. Deposited relatively near the volcano. A good road material. Many places in the West; New Mexico; Arizona, etc.

9. *Rhyolite.*

   Texture, dense; usually having a few visible crystals of some hard mineral. Structure, massive, solid; often showing flow lines, which property gives the rock its name. Color, brown of different shades, and grayish. Very hard and tough. Luster, dull. Composition, similar to granite; highly siliceous. Useful for paving blocks, concrete, etc.; too hard to be profitably quarried for building stone. Common in the West; Black Hills; Colo.; Nev.; also in the Lake Superior region; near Portage, Wis., etc.

10. *Andesite.*

    Texture, dense. Structure, massive, solid; sometimes cellular; sometimes porphyritic. Color, usually dark gray. Composition, little or no free quartz, abundant hornblende or biotite, and lime-soda feldspar. Of wide occurrence in the West; Colo.; the Comstock lode, Nev.; Mt. Shasta, etc.; also in western Mexico and South America.

11. *Basalt.*

Texture, dense. Structure, massive, solid; sometimes somewhat porous; often porphyritic: sometimes with cavities filled with minerals deposited subsequently, which form is called amygdaloidal basalt. Color, usually black, or very dark gray. Heavy. Composition, plagioclase feldspar, augite, olivine, and magnetite, chiefly; quartz absent. Widely distributed; extrusive rocks, perhaps the most widely of all igneous rocks; India; Snake River region; Arizona; New Mexico, etc.; also around Lake Superior, of pre-Cambrian age.

12. *Diabase.*

Texture, intermediate between the dense and the typical ''grained'' rocks, very finely crystalline. Structure, massive, solid. Color, greenish gray to dark gray. Heavy. Composition, much the same as basalt. A good road metal. A dike rock. Occurs widely; many prominent landmarks in the East, as the Palisades on the Hudson, etc.

13. *Granite.*

Texture, grained, the individual minerals large enough to be distinguished easily. Structure, massive, solid; often porphyritic. Color, gray, reddish, pinkish, etc. Composition, quartz, orthoclase feldspar, and mica; both biotite and muscovite are common; hornblende may replace part or all of the mica. The most commonly used igneous rock; for buildings, monuments, etc. Of wide occurrence; Vermont; Mass.; Appalachian region; Wis.; Minn.; Rocky Mountain region. An intrusive rock.

14. *Syenite.*

Texture, grained, like granite. Structure, massive, solid. Color, gray to white, pinkish, reddish. Composition, orthoclase feldspar and hornblende; some have more mica and less hornblende; plagioclase, apatite, and magnetite present in small amounts; quartz absent. Use, much the same as granite; more easily worked. Occurs in masses like granite; not so common as granite; White Mountains; Little Rock, Ark.; Custer County, Colo.

15. *Monzonite.*

Texture, grained. Structure, massive, solid; often porphyritic. Color, gray, pinkish. Composition, orthoclase and plagioclase feldspar in equal amounts and hornblende; intermediate in composition between syenite and diorite. Abundant in the West.

16. *Diorite.*

Texture, grained. Structure, massive, solid. Color, dark gray to greenish, or almost black. Composition, hornblende, biotite, and plagioclase feldspar; sometimes with considerable quartz.

17. *Gabbro.*

Texture, grained. Structure, massive, solid. Color, gray to black, greenish. Composition, essentially plagioclase feldspar and pyroxene. Used locally to some extent for buildings. Prominent localities, around Lake Superior, Duluth, etc.

SEDIMENTARY ROCKS

18. *Rock Salt.*

Texture, crystalline. Structure, massive, solid. Color, clear, grayish, reddish. Taste, salty. Composition, common salt; sometimes with impurities of oxides of iron, silt, etc. A source of salt. Of wide occurrence, in beds, associated with gypsum, etc., deposited in inland seas of past geological ages.

19. *Gypsum.*

Texture, crystalline, fine-grained to dense. Structure, massive, solid; sometimes fibrous or foliated. Color, white; sometimes stained by impurities of iron oxides, clay, etc. Composition, pure or nearly pure gypsum. Uses, (see No. 61 in "Description of Minerals").

20. *Flint.*

Texture, dense. Structure, nodular; also in layers interbedded with limestone; also in rough, irregular bodies within masses of limestone. Hardness, 7. Fracture, conchoidal. Luster, dull. Occurs in chalk beds, as nodules. Color, black to grayish or white. Composition, nearly pure silica. Occurs in many parts of the world, associated with carbonates of iron or of lime; the iron ores of the Lake Superior region have developed from the "cherty iron carbonates" of pre-Cambrian rocks. Other names practically synonymous are chert and hornstone.

21. *Jasper.*

Texture, dense. Structure, massive, solid. Color, red, yellow, etc. Hardness, 7. Luster, dull. Composition, silica, with oxides of iron in small amount. Associated with iron ores in the Lake Superior region.

22. *Geyserite.*

Texture, compact. Structure, spongy or solid; cauliflower-like, tuberoid. Luster, dull. White or grayish. Hardness, 7. An encrustation, formed around hot springs and geysers.

23. *Diatomite.*

Texture, fine, gritty. Structure, bedded or massive, porous to earthy, friable. White. Light weight. Composition, mainly hydrous silica and alumina; the microscopic shells of diatoms, with certain impurities. Used as an abrasive; for packing steam pipes, etc. Occurs in thick deposits, in Santa Barbara County, Calif.; near Reno and Goldfield, Nev., etc. Called diatomaceous earth.

24. *Calcareous Tufa.*

Structure, crust-like, coralloid, or arborescent; rounded or cauliflower-like forms. White to yellowish or grayish. Hardness about 3. Effervesces in acid. Composition, mainly calcium carbonate. A deposit from springs, especially those flowing from limestone rocks.

25. *Travertine.*

Structure, fibrous or splintery. Yellowish. Hardness, 3. Effervesces in acid. Composition, calcium carbonate. A deposit in limestone caves. Mexican onyx is a similar deposit having a beautifully-banded structure. Mexican Onyx is used for interior decoration, table tops, ornaments, etc.

26. *Chalk.*

Texture, fine. Structure, massive, friable. White to yellow or grayish. Hardness, not over 3. Effervesces in acid. Composition, essentially calcium carbonate. A deposit formed in the ocean, consisting mainly of the minute shells of foraminifera. Used for crayons, Portland cement, etc. Of wide occurrence; southern United States; Nebr.; S. Dak.; England, the "Cliffs of Dover," etc.

27. *Marl.*

Structure, earthy to friable. Effervesces in acid. White to grayish. Contains fragments of shells, silt, and material secreted by plants growing in shallow lakes; largely calcium carbonate in composition. Useful for the manufacture of Portland cement.

28. *Coquina.*

Structure, a rather loosely-cemented mass of fragments of shells. Occurs on the coast of Florida.

29. *Oolitic Limestone.*

Texture, granular. Structure, massive, solid; formed of small fragments of shells and sand-like grains having a concretionary structure. Effervesces in acid. Nearly pure calcium carbonate. Hardness, 3. White to grayish or cream-colored. An excellent building stone; very extensively used for that purpose throughout the United States. The most productive region is around Bedford, Indiana. Called "Bedford limestone."

30. *Hydraulic Limestone.*

Texture, fine. Structure, massive, solid. Color, gray, bluish to dark gray. Contains impurities of magnesia, silica, and clay, in such proportions that the stone forms a natural hydraulic cement, after burning and grinding.

31. *Ordinary Limestones.*

Textures, variable; coarsely crystalline to very dense. Structure, massive, solid; some kinds, highly fossiliferous; others, with nodules of chert as the most prominent characteristic. Colors, variable; nearly white, grayish, buff, bluish gray, brownish, black, etc. Effervesce in acid. Easily scratched with a knife. Useful for building stones, Portland cement, lime; some varieties are cut and polished for interior decoration, as marble. Widely distributed.

32. *Dolomitic Limestone.*

Resembles some limestones. Is harder, and does not effervesce readily in cold acid. Composition, calcium-magnesium carbonate, with small amount of impurities. A secondary rock, developed from ordinary limestone. Uses, similar to limestone as a building stone; also for furnace linings.

33. *Shale.*

Texture, fine grained to dense. Structure, in thin layers, parallel to the plane of deposition, more or less easily separable. More or less friable, or easily cut. Usually unctuous and plastic when powdered and mixed with water, like clay. Easily weathered, and forms gentle slopes rather than cliffs. Colors, variable; bluish gray to black, yellowish, greenish, white, red to brown, etc. Composition, variable; usually high in alumina; quartz in the from of silt; carbonaceous material, etc.; often with more or less calcite, grading into limestone. Used in manufacture of Portland cement; certain kinds contain hydrocarbons, from which oil may be distilled.

34. *Loess.*

Texture, fine, even-grained. Structure, loose or scarcely coherent; sometimes contains tubular or tubercular concretions; a characteristic feature is its ability to maintain a perpendicular surface for years without caving or slumping. Color, buff or grayish, except where decaying vegetation has given it a darker hue. Composition, mainly quartz; some clay and oxide of iron; also, some calcite. Forms a fertile soil over a large portion of central United States, especially prominent along the Missouri and Mississippi rivers, as bluffs.

35. *Novaculite.*

White. Texture, dense or very fine-grained. Structure, massive, solid. Luster, dull. Hardness, 7. Fracture, conchoidal. General appearance, much like chert, but the fracture-surface is slightly rough to the touch. Composition very fine quartz grains. Used as oilstones, for sharpening tools. Principal occurrence is in Garland and Salina counties, Arkansas.

36. *Sandstone.*

Textures, variable; fine to coarse, rough; porous. Structure, massive to thin-bedded, porous; sometimes showing stratification, crossbedding, etc.; friable to very coherent, according to the amount and kind of cementing material. Hardness, 7. Color, variable; from nearly white to gray, yellowish to red, brown, green etc. Composition, essentially quartz sand, cemented by silica, iron oxide, or calcite. An abrasive; used in manufacture of glass; in mortars; as a building stone, etc. Widely distributed.

37. *Conglomerate.*

Structure, massive to bedded, solid; a deposit of rounded gravel and pebbles, cemented into a coherent mass. Color, variable, according to the materials making up the mass or of the cementing material; gray, reddish, spotted, etc. Composition, more variable than sandstone, but most commonly a collection of the harder kinds of materials. Called also "pudding stone." Breccia is similar, but the different ingredients are angular instead of being rounded.

METAMORPHIC ROCKS

38. *Gneiss.*

Texture, coarse-grained. Structure, massive, solid, laminated to a certain extent; in bands or layers consisting of alternating quartz and feldspar, and some darker mineral, as hornblende or biotite. Color, light gray to dark; more or less streaked or banded; often much contorted or crumpled. Composition, much like granite. Derived from a granite or a sedimentary rock.

39. *Schist.*

Texture, fine-grained to rather coarse. Structure, foliated, separable into moderately thin leaves having a more or less wavy form, or into flaky particles all oriented in the same direction. Color, variable; gray, green, white, black, Composition, variable; feldspar usually absent; nearly pure minerals from the respective types—talc schist, hornblende schist, mica schist, chlorite schist, etc.; quartz often present with the different types, and is itself the main constituent in quartz schist; garnet is often present in mica schists. Schists grade into slates.

40. *Slate.*

Texture, fine, dense. Structure, lamellar, cleaving into thin, flat plates; this cleavage not to be confused with the parting along bedding plane, as in shale. On fresh cleavage surface often appears a faint satiny luster. Hard and resistant to weathering, but may be scratched by a knife. Color, black, green, or reddish. Contains a variety of minerals in very small particles, chiefly quartz, mica, chlorite, and carbonaceous matter. Used for roofing and blackboards.

41. *Quartzite.*

Texture, grained, crystalline. Structure, massive, solid; often showing stratification lines; sometimes showing the original sand grains. Luster, vitreous. Color, pink, purplish, yellowish, gray, etc. Fracture, conchoidal, like quartz. Hardness, 7. Composition, mainly quartz; coloring matter of rock due to impurities. Used for paving blocks. Occurs in eastern United States; Rocky Mountains; Lake Superior region; southeastern South Dakota, etc.

42. *Marble.*

Texture, grained, crystalline. Structure, massive, solid, not laminated or stratified; often possesses a clouded or marble appearance, on acount of metamorphism undergone. Color, white, gray, yellow, red, brown, bluish, etc.; clouded, streaked, or blotched. Hardness, 3. Composition, carbonate of lime, with frequent impurities. Fossils absent. Important building stone, especially for interior finish; monuments; statuary. Called crystalline limestone. Found in regions that have been much folded; Vermont; Mass.; N. Y.; Ga.; Tenn.; Colo.; etc.

43. *Dolomotic Marble.*

Texture, crystalline, as in calcite marble. Appearance, much the same as calcite marble. Hardness, a little greater than calcite. Does not effervesce in cold acid. Composition, dolomite, with various silicate minerals developed from former impurities in the sedimentary rock. Use, buildings; statuary; etc. Occurs in Tyrolese Alps; Vermont, etc.

44. *Ophicalcite.*

Texture, crystalline to dense. Structure, solid, irregularly intermixed masses of serpentine and calcite or dolomite. Color, mottled green and white. Used for interior decoration. Occurs in Canada; N. Y., etc.

45. *Serpentine.*

Texture dense to grained· Structure, solid, massive. Color, green of several shades, yellowish, brownish. Luster, greasy or waxy. Composition, mainly serpentine, but often with impurities. Used for interior decoration. Occurs on Staten Island; the Pacific Coast ranges, etc.

46. *Soapstone.*

Texture, coarse-grained. Structure, solid, massive. Color, grayish green, brownish gray. Hardness, 1-2.5. Composition, mainly talc. Used for laboratory tables, sinks, etc. Produced in N. Y.; Va.; Vt.

GLOSSARY

ACIDIC. Containing much silica—more than 65%.

BASIC. Containing less than 55% of silica; high in magnesium and iron.

CONCHOIDAL. Shell-like; applied to fracture. Glass breaks with a conchoidal fracture.

CLEAVAGE. A property of some minerals by which they tend to break along a plane, or planes, rather than irregularly. The property persists, no matter how small the particle. A similar property is possessed by some rocks, "slaty cleavage," which is due to other causes.

CRYSTAL. A solid of definite molecular structure, formed through the action of molecular forces, and having a regular shape with plane surfaces.

CRYSTALLINE. Having the structure of a crystal or part of a crystal, or of an aggregate of these.

CRYSTALLIZED. Having passed from a solution, or a vapor, to a crystalline solid.

DENSE. A condition of texture midway between "glassy" and "grained"; not perceptibly crystalline; having a dull luster on a freshly fractured surface.

DIKE. An intruded igneous rock cutting through other rocks, and usual-vertical in position; in thickness, varying from a fraction of an inch to several rods.

EFFEREVESCE. To dissolve with bubbling, due to the evolution of gas.

FOLIATED. In thin, separable leaves or bands.

GANGUE. Rocks or non-metallic minerals associated with an ore, and which are frequently removed with the ore.

GLASSY. Having the appearance of glass; a term descriptive of a certain texture, of igneous rocks, in which crystallization has made little or no progress.

GRAINED. A type of texture having crystalline particles large enough to be noticed; like granite.

GRANULAR. In grains, as of sand; not necessarily crystalline.

GRAVITY. Specific gravity; the ratio of the weight of a given volume of a substance to an equal volume of water; indicated in the tables by "G."

HARDNESS. The degree of resistance to abrasion; indicated in the tables by "H."

IGNEOUS. Derived from fused material in the earth.

LUSTER. The appearance of the light reflected from a surface, as vitreous, resinous, etc.

MAGMA. Igneous rock that has not solidified.

Massive. In large, homogeneous masses, with no indication of bedding.

Metamorphism. A change in the mineral content of a rock and a rearrangement of its structure, mainly as the result of excessive heat, water, and crustal movements.

Mineral. A homogeneous substance of definite chemical composition, naturally occurring, and of inorganic origin.

Oolitic. Like fish eggs; in small round grains, having a layer-like structure.

Opaque. Not allowing light to pass through.

Ore. A mineral, usually metal-bearing, occurring in a deposit sufficiently rich to be profitably mined.

Oxidation. The process of combining with oxygen, resulting in the simplification and stablization of matter under atmospheric conditions.

Oxidized zone. The portion of the earth's crust in which oxidation acts; practically coincident with the "zone of weathering."

Pegmatite. Coarse crystal aggregates resembling granite in composition, but with many accessory minerals such as tourmaline, beryl, fluorite, etc.; usually occurring in dike-like forms.

Plagioclase. A group of feldspars in which the two cleavages form an angle of 85° to 86° instead of 90° as in orthoclase. Labradorite and albite belong to this group.

Porous. Containing minute openings, as the interstices in sandstone.

Porphyritic. Having conspicuous crystals embedded in a finer-textured mass, which may be glassy, dense, or grained.

Primary. The original condition of a deposit, as it was laid down.

Replacement. The process of interchange whereby one mineral is dissolved and carried away while another occupies its place.

Secondary. A term descriptive of deposits that have resulted from the alteration of primary deposits by decomposition, replacement, or enrichment.

Sectile. Capable of being whittled into more or less cohesive shavings.

Solid. The quality of being free from cavities.

Structure. The larger features of a rock and their arrangement.

TRANSLUCENT. Allowing light to pass through but not permitting object to be seen.

TRANSPARENT. Clear, so that objects are visible through the substance.

VITREOUS. Glassy; having the luster of glass.

VEIN. A deposit formed in a crevice or seam in rocks, precipitated from solution.

ZONE OF WEATHERING. The part of the earth's crust lying generally between the surface and groundwater level.